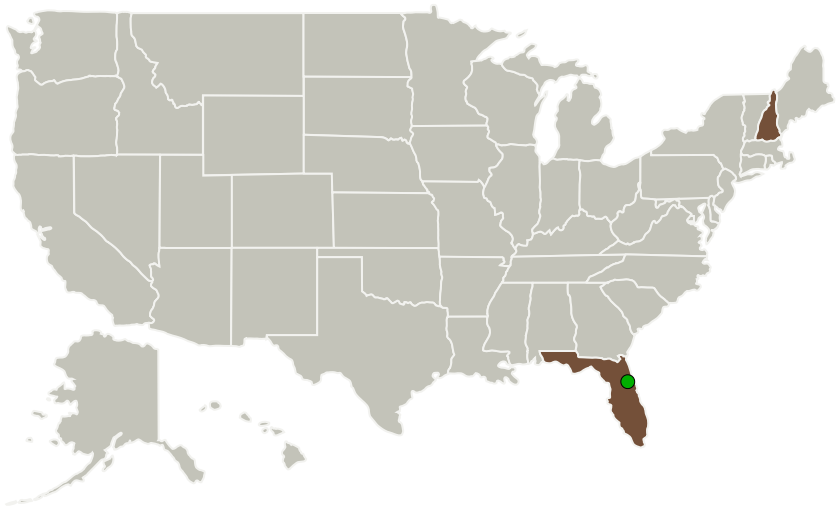
An Advanced Wet Expansion Turbine for Hydrogen Liquefaction, Phase II

Completed Technology Project (2012 - 2014)

Project Introduction

This proposal is responsive to NASA SBIR Topic X10.01, specifically, the need for efficient small- to medium-scale hydrogen liquefaction technologies, including domestically produced wet cryogenic turboexpanders. Future NASA missions will require hydrogen liquefaction systems for spaceport, planetary, and lunar surface operations. A critical part of these systems is the cryogenic expansion turbines, which must be designed for high-speed operation and long life, and must be robust against the pressure and momentum excursions and the surface tension effects associated with two-phase flow. On the Phase I project, we identified and optimized a liquefaction system for spaceport operations. We demonstrated by analysis the benefits of using expansion turbines in the product stream instead of the customary Joule-Thomson throttle. We designed a set of high-performance turbines for use in these systems. On this Phase II project, we will demonstrate cryogenic expansion turbines for use in hydrogen liquefiers. The expansion turbines will be reliable, compact, lightweight, and efficient and will be able to operate in a two-phase system. They will have the innovative feature of recovering the expansion work through use of an alternator instead of dissipating work through a brake wheel. This approach greatly simplifies controls, improves reliability, and reduces system mass and input power.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations	
Florida	New Hampshire

Project Transitions

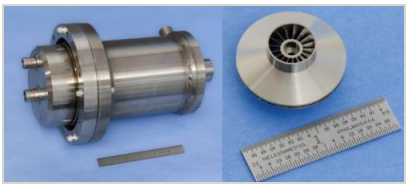
April 2012: Project Start

April 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137919)*

Images



Project Image
An Advanced Wet Expansion Turbine for Hydrogen Liquefaction *(https://techport.nasa.gov/image/133781)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Creare LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Mark Zagarola

Co-Investigator:
Mark Zagarola

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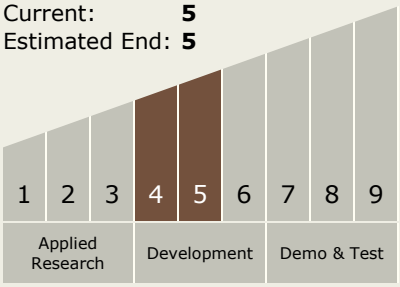
Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System